

Five-year review of intraoperative pathology consultation in a single institution

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ABSTRACT

Intraoperative pathology consultation plays an important role in the management of surgical patients and is also a measure for quality control in surgical pathology. A retrospective study was conducted to review intraoperative consultation during a 5-year period at a single institution. There were 19,145 intraoperative pathology consultation cases, including 19,026 concordant cases, 71 (<1%) frozen discordant cases, 11 (<1%) gross discordant cases, and 37 (<1%) deferred cases. Among frozen discordant cases, the most common cause for discordance was histologic sampling error (52.1%), followed by misinterpretation (42.3%). The most common major (clinically significant) frozen discordance was histologic sampling error for skin margins (32.4%), followed by histologic sampling error for lymph node metastasis (13.5%). Although our discordant rate (0.43%) was lower than that in previously reported studies (2%–8%), our major discordant rate was relatively high (50%). This review suggests that deeper sectioning of the blocks could improve the quality of our intraoperative consultations.

KEYWORDS Errors; false-negative; false-positive; frozen section; intraoperative consultation; misinterpretation; quality improvement; sampling

Intraoperative pathology consultation has long been applied to verify/categorize a lesion, evaluate surgical margins, determine the organ of origin, and assess tissue adequacy for further diagnostic studies with the expectation that the diagnosis will be deferred.^{1,2} The most important purpose is to guide the surgeon in making an immediate decision for the surgical procedure, which may decrease the need for repeat or additional surgical procedures. Periodic review of the correlation between intraoperative consultation diagnosis and final diagnosis is a key component of anatomic pathology laboratory quality assurance and is required for certification by the College of American Pathologists (CAP). The CAP conducted multiple large interinstitutional studies that showed an average concordance rate of approximately 98% and demonstrated that institutions participating in correlation monitoring were able to decrease the discordance rate to <1% over 5 years.^{3,4} In this study, we reviewed and analyzed 5 years of intraoperative consultation cases, including assessment of the diagnostic accuracy, the rates of deferral and discordance, and the reasons for discrepancies.

METHODS

A retrospective review of all intraoperative consultation (n = 19,145) in a multihospital single institution from January 2014 to December 2018 was performed. The final diagnosis from the surgical pathology report was compared to the intraoperative consultation diagnosis. All cases were then classified as concordant, gross discordant, frozen discordant, or deferred. Further analysis categorized discordance and deferral by organ system, causes of errors, types of errors, and clinical impacts. The causes of errors included gross discordance (gross misinterpretation with no frozen performed) and frozen section discordance (further subclassified as gross sampling error, histologic sampling error, and diagnostic misinterpretation). Gross sampling error occurred when the lesion was present in the specimen but the lesional area was not sampled for the frozen section. Histologic sampling error occurred when the lesion was not present on the frozen section slide but was positive on the permanent slide from the same block (deeper section). The types of errors included over-calls (false-positive), under-calls (false-negative), and misclassifications. The discordant cases were subsequently grouped based on the clinical impacts as no/minor clinical

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Table 1. Total discordances and deferrals by organ system among 19,145 intraoperative pathology consultations at a single institution

Organ system	Frozen section discordance	Gross discordance	Deferral	Total
Skin	17	0	0	17
Head and neck	17	6	10	33
Lymph node	14	0	0	14
Breast	1	2	2	5
Nervous system	9	0	5	14
Female genital tract	3	1	5	9
Urinary tract	3	0	3	6
Hepatopancreatobiliary	2	1	3	6
Gastrointestinal tract	2	1	1	4
Bone and soft tissue	0	0	4	4
Thorax (lung, pleura, mediastinum)	2	0	2	4
Male genital tract	0	0	0	0
Cardiovascular system	0	0	0	0
Other	1	0	2	3
Total	71	11	37	119

significance or major clinical significance. Minor clinical impact was defined as no/minimal risk of harm, while major clinical impact indicated changes in clinical treatments, including inappropriate surgical staging or the requirement for additional surgeries. Deferrals were not considered to be discordances and were analyzed independently. We also tracked the discordant cases by pathologists' years of experience in practice (≤ 5 years = junior and >5 years = senior) at the time of intraoperative consultations.

RESULTS

In the 5-year period of retrospective review involving 19,145 intraoperative pathology consultations, 119 discrepancies/deferrals were identified, including 82 (0.42%) discrepant cases and 37 (0.19%) deferred cases. The total discordances and deferrals by organ system are summarized in [Table 1](#). Eighty percent of intraoperative consultations were for verification/categorization of a lesion, 18.5% for margin evaluation, and 1.5% for determination of the organ of origin ([Figure 1](#)). All deferrals were for verification/categorization of a lesion. Of the 82 discordant cases, there were 11 cases with gross discordances and 71 cases with frozen section discordances. All the gross discordant cases were false-negatives, with more than half from the thyroid (54.5%). Among the 71 frozen section discordant cases,

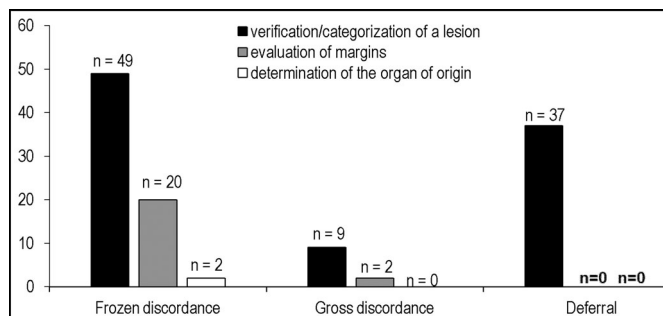


Figure 1. Indications for intraoperative consultation for cases with discordances and deferrals.

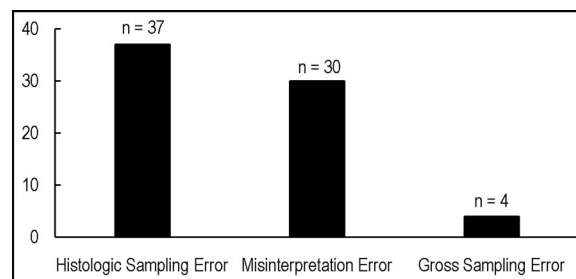


Figure 2. Causes of errors for frozen section discordances.

most cases were from the skin (24.9%) and head and neck (24.9%), followed by lymph node (19.7%). By organ system, head and neck was the most common anatomic site with discrepancies or deferrals (27.7%). The causes for frozen section discordances were histologic sampling errors (52.1%), misinterpretations (42.3%), and gross sampling errors (5.6%) ([Figure 2](#) and [Table 2](#)). The types of frozen section errors consisted of false-negative (73.2%), false-positive (14.1%), and misclassification (12.7%) ([Figure 3](#)). Thirty-seven frozen section discordant cases and four gross discordant cases (50%) caused major clinical impact, while the other 34 frozen section discordant cases and 7 gross cases (50%) resulted in minor clinical impact ([Table 2](#)).

For frozen section discordances with major clinical impact, the most commonly involved organ system was skin (37.8%, skin margin), followed by lymph node (24.4%, lymph node metastasis) and head and neck (13.5%). The most common cause of error was histologic sampling error (51.2%), followed by misinterpretation (35.1%) and gross sampling error (8.1%). Most frozen section errors were false-negative errors (91.9%); only two cases were false-positive errors (5.4%), and one case was a misclassification error (2.7%). An example of a false-positive case was a lymph node from a patient with invasive ductal carcinoma of breast, which was initially diagnosed as positive for metastatic carcinoma in the frozen section, while the final diagnosis was benign lymph node with subcapsular nevus ([Figure 4](#)). An example of a false-negative error was a distal ureteral margin from a patient with bladder urothelial carcinoma, which was misinterpreted as benign in the frozen section, while the final margin was positive for urothelial carcinoma, plasmacytoid variant ([Figure 5](#)).

Table 2. Total frozen section and gross discordances by organ system, clinical impact, and causes of error among 19,145 intraoperative pathology consultations at a single institution

Organ system ^a	Total frozen discordance									Total gross discordance		
	Total frozen	Major clinical impact			Minor clinical impact		No clinical impact			Total gross	Major clinical impact	No/minor clinical impact
		HS error	MI error	GS error	HS error	MI error	HS error	MI error	GS error			
Skin	17	12	2	0	1	0	1	1	0	0	0	0
Head and neck	17	4	0	1	6	2	1	2	1	6	1	5
Lymph node	14	5	4	1	2	1	1	0	0	0	0	0
Breast	1	0	0	1	0	0	0	0	0	2	2	0
Nervous system	9	0	1	0	1	7	0	0	0	0	0	0
Female genital tract	3	0	2	0	0	0	1	0	0	1	1	0
Urinary tract	3	0	2	0	0	1	0	0	0	0	0	0
Hepatopancreatobiliary	2	0	0	0	0	1	1	0	0	1	0	1
Gastrointestinal tract	2	0	1	0	1	0	0	0	0	1	0	1
Thorax (lung, pleura, mediastinum)	2	0	0	0	0	2	0	0	0	0	0	0
Other	1	0	1	0	0	0	0	0	0	0	0	0
Total	71	21	13	3	11	14	5	3	1	11	4	7

GS indicates gross sampling; HS, histologic sampling; MI, misinterpretation.

^aNo discordance was present in bone and soft tissue, male genital tract, or cardiovascular system.

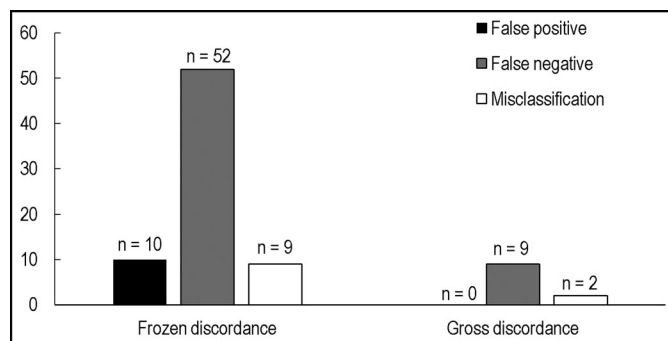


Figure 3. Types of errors for frozen section and gross discordances.

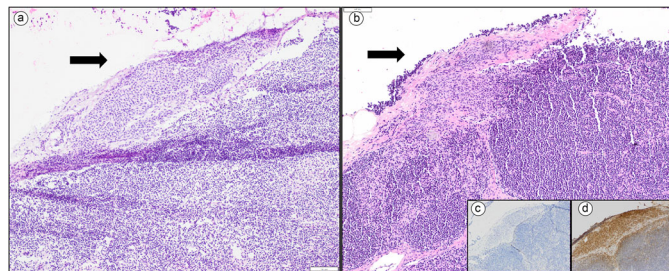


Figure 4. False-positive error in a lymph node specimen. (a) Frozen section and (b) permanent section of lymph node with nevus (arrow), hematoxylin and eosin, 100 \times . (c) Negative pankeratin AE1/AE3 immunostain, 100 \times . (d) Positive S100 immunostain, 100 \times .

The four gross discordant cases with major clinical impact included two breast cases for evaluation of margin,

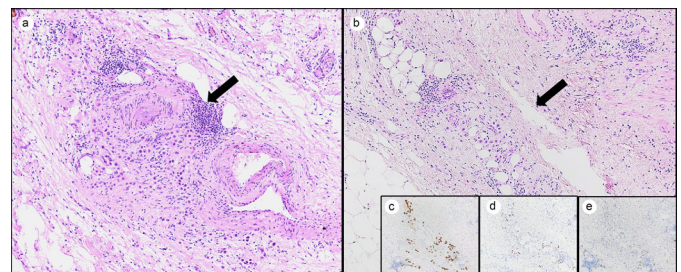


Figure 5. False-negative error in a ureteral margin specimen. (a) Frozen section and (b) permanent section of ureteral margin with urothelial carcinoma, plasmacytoid variant (arrow), hematoxylin and eosin, 100 \times . (c) Positive pankeratin AE1/AE3 immunostain, 100 \times . (d) Positive GATA3 immunostain, 100 \times . (e) Positive CD138 immunostain, 100 \times .

one thyroid case, and one ovarian case for verification of lesion. All four cases were false-negative cases.

Our pathology group between 2014 and 2018 comprised 14 senior pathologists (>5 years of practice) and 6 junior pathologists (\leq 5 years of practice) who did the intraoperative pathology consultations. On average, junior pathologists had more frozen cases per year (126 cases) than senior pathologists (93 cases). The average rate of discordance with major impact was 2.6% cases per year per senior pathologist and 1.8% cases per year per junior pathologist. These findings were not statistically significant ($P > 0.05$).

Among 71 discordant frozen section cases, 10 cases (14%) had intradepartmental consultations. Most intradepartmental consultations were for verification/categorization

of lesion (50%), followed by evaluation of margin (40%). In this study, we only collected the intradepartmental consultation data from the discordant frozen cases but did not include all frozen cases.

DISCUSSION

Our investigation of the correlation of intraoperative consultation with final diagnosis showed a concordance rate of 99.4% and a deferral rate of 0.2% over a 5-year period. Previous studies have shown a concordance rate ranging from 87% to 98.6% and a deferral rate ranging from 1.3% to 4.8%.^{2,3,5-8} That rate was influenced by a higher percentage of cases with frozen sections and higher numbers of frozen sections per case. Our study showed a slightly higher concordance rate and lower deferral rate that might be due to better suited specimen types on frozen sections, less frozen sections per case, more intradepartmental consultation, and exclusion of the deferrals.

For our study, the causes of the frozen section discordances were delineated based on a classification tool designed by Sams et al.⁴ The CAP interinstitutional comparison of frozen section consultation studies showed that the most common cause for diagnostic discordance was tissue sampling.^{2,5} However, other studies, including the Mayo Clinic study, found that misinterpretation was the most common cause of errors.^{1,4,9,10} In our study, we found that histologic sampling was the most common cause for frozen section errors. Most cases with major errors were for margin evaluation.

Routine deeper sections in the frozen section block (unless the frozen section is performed on tissue oriented en face) and/or sampling additional tissue if the initial section is negative may lower the error rate resulting from sampling errors, especially if there is a high index of suspicion for malignancy.⁵ In a study by Olson et al,¹¹ three-level sectioning for head and neck frozen section margins reduced the sampling error rate by a modest degree compared to two-level sectioning. Despite lack of consensus regarding how to handle such specimens, most centers simply cut two full hematoxylin and eosin sections with a possible third-level cut at the pathologist's request.^{12,13} Cutting more sections of the tissue likely increases the chance for finding especially tiny foci of tumor. Our study suggests that cutting additional levels during frozen section consultations would significantly reduce the error.

Our study showed a 0.19% deferral rate, which is comparable to previously published studies with deferral rates ranging from 0.04% to 6.7%.¹ Most deferral cases were from the head and neck, followed by the nervous system and female genital tract. The reasons for these deferral cases were for categorization of a lesion; for most of them, a benign vs malignant diagnosis could not be made. The deferral rate may vary depending on clinical expertise, clinical setting, and type of specimens.³ It is also worth noting that the deferral may not have a uniform agreed-upon definition. Some deferral cases may not be appropriately classified as deferrals as

they were actually discordant (false-negative), such as the scenario that a spindle cell neoplasm with obvious malignant features was deferred and not called malignant during frozen consultation.⁴

Previous studies have shown that experience plays a major role in interpretation of frozen sections, as there is lower deferred and error rates when the specimen is interpreted by more experienced pathologists. In addition, evaluation of the specimens by two or more observers, when there is uncertainty, reduces the rate of error.^{1,6} At our institution, intradepartmental consultations are encouraged and frequently performed, which is likely one of the factors that contributed to our lower discordant rate and lack of statistical difference on the rate of major discordance between junior and senior pathologists.

A CAP interinstitutional comparison of frozen section consultation in small hospitals⁵ showed that most discordant diagnoses (82.6%) were discussed and reconciled in the final pathology report. In consultation with the surgeons or based on chart review, the pathologists evaluated the discordant diagnoses with respect to their effects on patient care. The study suggested that reconciliation is an essential part of quality assurance that would help in building confidence among physicians, and ideally all discordances should be reconciled in the final pathology report. In our study, most frozen section cases with major errors had reconciliation in the final pathology reports (86.5%).

In conclusion, monitoring intraoperative consultation discrepancy and deferral rates provides substantial information, and in-depth analysis of this information is helpful in finding the causes of the errors, thus potentially reducing the overall rates of discrepancies and deferrals. Although our discordant rate (0.43%) is lower than reported rates (2%–8%), the major discordance rate was relatively high (50%). Our study suggests that deeper sectioning of the blocks could improve the quality of our intraoperative consultation.

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Avocations



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